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Exploring CSCW Mechanisms to Realize Constant Accessibility Without Inappropriate Interaction

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Abstract

We want to enable users of CSCW technologies constant accessibility without inappropriate interaction. Informed by empirical studies, we suggest two mechanisms to realize the objective. The accessibility mechanism filters incoming interaction based on the accessibility plan of users. The awareness mechanism helps people to form an understanding of each others' activities in the process of establishing interaction. To demonstrate how the mechanisms could be implemented, we describe a PC based prototype application called the Interaction Manager. We conclude that the two mechanisms help people extend accessibility and decrease inappropriate interaction.

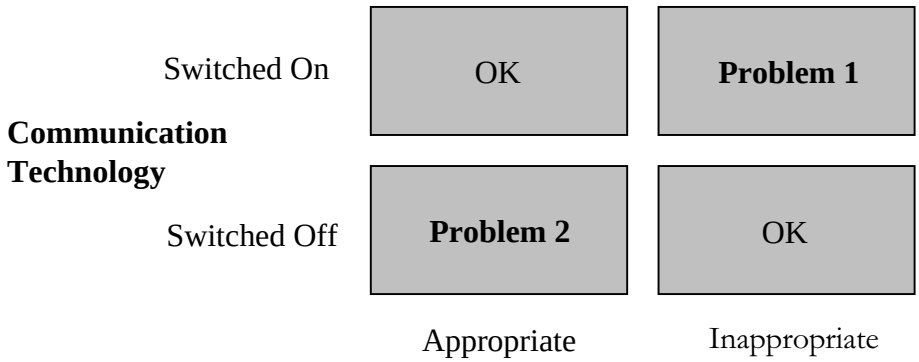
Keyword: CSCW, accessibility, awareness, application, interaction.

1. Introduction

In this paper, we report and elaborate on the results of a field study in a pharmaceutical research organization. The objective of the study was to facilitate the design of mechanisms that help users of CSCW (Computer Supported Co-operative Work) technologies to be accessible constantly without running the risk of inappropriate interaction. Currently, this is not possible, and people experience problems accordingly. Let us start with considering this problem in some more detail.

Most communication technologies assume accessibility to be binary. Users are assumed to have two preferences. Either they want to be accessible, or they do not want to be accessible. According to our empirical studies, this is not a valid assumption. On the contrary, people want to be accessible constantly, but never for all kinds of communication (Ljungberg 1996; Ljungberg and Sørensen 1996). To handle this mismatch, people often handle accessibility by switching on and off the technology. Two kinds of problems occur accordingly (Ljungberg 1997): First, they miss appropriate communication when the technology is switched off. Second, they receive inappropriate communication when the technology is switched on. These two problems are here called the “communication problem,” shown in figure 1.

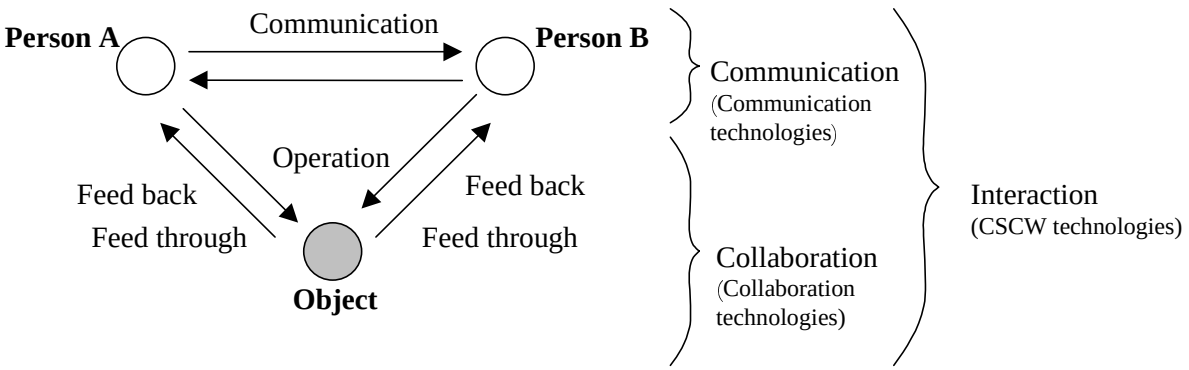
Figure 1: The communication problem: people miss appropriate communication and receive inappropriate communication.



The "communication problem" calls for mechanisms that enable constant accessibility without inappropriate communication. In the context of figure 1, all communication would then take place in the upper left box ("switched on," "appropriate"). Initially, this was the objective of our research.

Many models of CSCW make a distinction between communication and collaboration. The "CSCW framework" suggested by Dix and Beale (Dix and Beale 1996) is one example (see figure 2). According to this model, communication is the exchange of information between people, e.g., video conferencing. Collaboration is two or more people operating a common object (or artifact), e.g., co-operative authoring where the shared document is the common object. In collaboration, operations produce "feedback" to the operator, but also "feed through" to co-workers. Support for collaboration is sometimes combined with support for communication, e.g., a collaborative authoring system (collaboration) equipped with a chat feature (communication). In the context of this model, we can conceive communication and collaboration as subsets of "interaction." Furthermore, we can use "CSCW technology" to frame the technological support for interaction, i.e., communication technology and collaboration technology. This is shown in figure 2.

Figure 2: CSCW technologies support communication, collaboration, or both (based on (Dix and Beale 1996)).



Assuming that the "communication problem" documented in the fieldwork can take place in all kinds of interaction, we re-directed the focus of the research from "communication" to "interaction" in general. We defined as our objective to explore mechanisms that

enable users of CSCW technologies constant accessibility without inappropriate interaction. Note that CSCW technologies here include communication and collaboration technologies, and that interaction comprises communication and collaboration.

To aid in the explorations and design of such mechanisms, we conducted an empirical study. The study investigated the work of clinical trial personnel at a pharmaceutical research company. The trial personnel manage large clinical trial projects. Because the projects involve people from different countries around the world, this work requires the use of CSCW technologies. Examples of CSCW technologies used in the trials are email, fax, Lotus Notes, the telephone, and a meeting support system.

The objective of this paper, is to summarize the analysis of the empirical data collected in the study, discuss the implications for design derived from the empirical results, and finally, describe the "Interaction Manager," which is a prototype system designed on the basis of these implications. The Communication Manager is based on two mechanisms, called the accessibility mechanism and the awareness mechanism. The accessibility mechanism enables people to implement plans for their accessibility, while the awareness mechanism helps collaborators to become aware of each other in the process of establishing communication.

The rest of the paper is structured as follows: In section 2, we outline the context of the empirical research. In section 3, we summarize the results of the empirical work. In section 4, we demonstrate how these mechanisms were implemented in a prototype application called the Interaction Manager. In section 5, we discuss the research and its contribution, and finally, in section 6, we conclude the paper and give some suggestions for further research.

2. Research context

In this section, we describe the research site and method of the study. We also outline the work process of the clinical trial staff investigated.

2.1 Site

The empirical studies were carried out at a research subsidiary of a multi-national pharmaceutical company in Sweden. The subsidiary has about 1000 employees and the turnover last year was about $400,000,000. Approximately 750 of the 1000 employees are directly involved with the pharmaceutical research. The company is organized in three divisions: the pharmaceutical division, the pre-clinical division, and the clinical division.. The clinical division employs 350 researchers of which 50 work at the third Clinical Research Management department, or "CRM III," where the main part of our fieldwork was carried out. The clinical division does research concerning the use of investigational drugs in humans. These drugs have already passed through the pre-clinical (non-human) research. Because the authorities certify drugs for certain indications, not the drug per se, much clinical research is about exploring new indications for already approved drugs.

CRM III is organized in project groups served by administrative staff and the Data Management group. The project groups, also called research programs, are assembled on a three to six year basis, to manage clinical trials investigating a set of related hypotheses. The project groups consist of a group manager, clinical trial managers and secretaries. The clinical trial managers are responsible for one clinical project each, but they usually also do some work in other projects. The trial managers are assisted by the secretaries, who do much of the administrative work, e.g., order and distribute equipment for the trials. The group managers are responsible for coordinating the work in the groups.

2.2 Method

We have carried out two empirical studies at the pharmaceutical company. The first study was brief and exploratory. It comprised qualitative interviews with people from different sites at the clinical division: clinical trial managers and project leaders concerned with the pharmaceutical research, as well as designers at the local IT department. Relying on a criterion sampling approach (Patton 1990) saying that the objects of study should use much IT and be engaged in much collaborative work, nine people were chosen for interviews. Qualitative interviewing was chosen as mode of inquiry (Mason 1989). The study is described in more detail in (Ljungberg 1996; Ljungberg and Sørensen 1996). The analysis of the first empirical study shed light on problems related to the use of communication technology in work.

The second study aimed to inform the design of mechanisms that could enable people constant accessibility without inappropriate interaction. The study was carried out during a period of four months, and it was primarily concerned with the work in the Dyspepsia group. The group employs six people: one group manager, three clinical trial managers, and two secretaries. Participant observation of the Dyspepsia group was the main mode of inquiry in this study. Approximately 80 hours were spent doing close participant observations, i.e., following every single step of one particular person (Patton 1990), and about 240 hours were spent doing so called site observation, i.e., talk to people, explore what was happening, etc. (Patton 1990). Field notes were taken continually, and everybody was aware of the research and its purpose.

Inductive data analysis was applied to derive patterns from the ethnographical data. This means that "…patterns, themes, and categories of analysis come from the data; they emerge out of the data rather than being imposed on them prior to data collection and analysis" (Patton 1990, p. 390). The analysis of the ethnographic study has been reported elsewhere (Ljungberg 1997).

In the following we will give a brief overview of the work in clinical trial projects, which was the main occupation of the Dyspepsia group.

2.3 The clinical trial projects

The work in the trial projects is dynamic. It relies much on the participants' ability to act appropriately in new situations. For example, the trial managers spend most of their time in the trials resolving problems experienced by project members, especially during the collection of data. "Situated work" in this context does not mean deviating from a redefined work process, but to rapidly take actions to resolve ambiguous situations and make a large project organization meet the deadlines. To cope with unpredictable situations and make the right decisions the trial managers consult others. Collaboration occurs not only among project members and people in the same research group, but also informally among people from various departments, projects, groups, etc. It is important to establish, and maintain, a personal network of peers with different experiences (cf., Kreiner and Schultz 1993). Collaboration among people in remote locations requires IT. Problems experienced by investigators, monitors, and other distributed project members, are mediated to the trial manager using IT. To resolve such problems, but also to discuss other issues in the projects, the trial manager often consults people they cannot easily access without the use of IT.

The work process of the clinical trial projects comprises the following distinct steps:

Composing the study protocol. In collaboration with experts on biological effects, statisticians, quality of life, health economy, medicine, marketing, national requirements, etc., the trial managers composes a "study protocol" describing what the study concerns: what to study, variables, patient criteria, etc. This is a truly collaborative endeavor involving many people. Interaction among people involved mainly takes place electronically.

Composing the Clinical Report Form (CRF). A CRF is designed based on the study protocol. The CRF contains a detailed description of the trial, e.g., the time scale, and the questionnaires that will be used in the study. The trial manager designs the CRF in co-oper-

ation with medical experts, statisticians, and others. Data coordinators from the Data Management group assist the trial manager in producing the questionnaires, using a dedicated module in FormFlow. It is often necessary to go back and do updates in the study protocol after the CRF is designed.

Preparing the study. Secretaries assist the trial managers in preparing and distributing equipment for the trial to the local monitors in the countries involved in the project (10 to 15). The monitors manage the project activities in one country, where they are employed at the company's local subsidiary, and they handle most of the contacts with the clinics.

Initiating the clinical trial. The trial manager, in collaboration with the group manager, medical experts, etc., arrange meetings in all countries participating in the study, where they describe the details of the study for the local monitors and investigators (doctors).

Collecting data. The investigators ask potential patients to participate in the study. The medical examination takes place, and the local monitors pick up the CRFs at the hospital. The investigators sends the CRF to the local monitor. The monitors check the CRFs and return the incorrect ones to the investigator. Cleaned CRFs are sent to the trial manager. The trial manager edits the CRFs and returns incorrect files to the monitors, who distribute them to the testers responsible, and so on. A project management application is used to keep track of the CRFs, the inclusion of patients, etc. Correct CRFs are handed over to data managers from the Data Management group. They enter the CRFs in a database that has been set up by data coordinators, also from the Data Management group. When all CRFs have been entered, the data coordinators test the consistency and logical order of the data. This process, as well as the entering of the data, often reveals errors, and the CRFs are returned to the trial manager, and so on. Data that cannot be corrected may be excluded. When all data is checked and invalid data is removed, the “clean file” stamp is set, which means that the data must not be updated any longer.

Analyzing the data. The Statisticians analyze the data and present a statistical report of the study.

Writing the clinical report and apply for a new drug or indication. Based on the statistical report, the trial manager and the group manager write a clinical report concluding the study. If the hypotheses are confirmed then the company may submit the documentation to the health authorities for registration purpose.

3. The accessibility mechanism and the awareness mechanism

In this section, we summarize and discuss the results of the second empirical study. The objective of the study was to inform the design of mechanisms that could enable people constant accessibility without inappropriate interaction. The result of the study was two mechanisms, called the accessibility mechanism and the awareness mechanism.

3.1 The accessibility mechanism: Planning accessibility

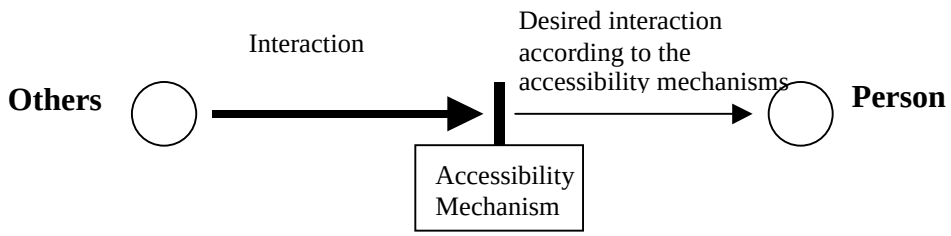
The concept of “session” is often used to describe the process of starting, proceeding, and stopping using a CSCW application (Patterson et al. 1990; Edwards 1994). The problem addressed in this paper is partly caused by deficiencies in “session control mechanisms,” i.e., the computing mechanisms that determine the manner in which users can join together in communication sessions (Patterson et al. 1990; Edwards 1994). A very simple but illustrating example is the telephones used at the pharmaceutical company, which were designed assuming that people only need two overall modes of accessibility: they want to be accessible by everybody or nobody. This assumption does not agree with the results of the empirical work, which suggests that the pharmaceutical staff *always* want to be accessible, but never by every single potential caller. Seemingly because people could not prescribe for

whom they want to be accessible, they had to choose whether they want to receive *all* or *no* calls, that is to say, run the risk of missing important sessions or receiving unfortunate calls.

The first study implies that this is not sufficient, as people miss appropriate communication when the technology is switched off, and receive inappropriate communication when the technology is switched on. This suggests the need for mechanisms that enable people to prescribe their accessibility, i.e., accessibility plans. We use the term *accessibility mechanism* to denote a feature that offers participants such support. The accessibility mechanism would decrease the two problems by enabling people to prescribe in advance what sessions they wish to become involved in during a particular period of time.

The accessibility mechanism filters incoming interaction based on the accessibility plan designed by the user. Out of all incoming interactions, the accessibility mechanism removes the interaction that is undesired according to the plan, and lets through the interaction that is desired according to the plan. Incoming interaction is either communication or collaboration ("feed through"). The accessibility plan could be based on many different sources, e.g., who seeks to interact, the system used, and the topic. The accessibility in the context of the CSCW model introduced in section 1, is shown below.

Figure 3: The accessibility mechanism filters incoming interaction according to a plan.



3.2 The awareness mechanism: Facilitating "the actual" process

Some employees were assisted by secretaries, to whom they more or less frequently re-routed their telephone. The main reason for doing that seemed to be that they did not want to be accessible for all telephone calls for a period of time, for instance, when hosting a meeting at the office, without having to be inaccessible for potentially important calls, some of which might be known in advance. Employees argued that the secretaries often were very "good filters," maintaining that they often "simply knew which calls to let through."

The secretaries were often aware of the receiver's work, e.g., what it concerned and who they usually co-operate with, but also more situated issues such as: why they had re-routed their telephone to them, which they often were told when the telephone was re-routed; if their current work was important, which they often knew by experience, and in situations were the secretary was situated close to the person in question and could monitor his actions; how the work actually proceeded. When the secretaries answered re-routed calls they sometimes realized immediately that the call should be re-routed to the person in question, e.g., they were explicitly told to re-route particular calls, they knew by experience that the caller was a very important person, or they knew that the meeting, for instance, was completed, e.g., by having seen staff saying good bye to visitors, but that the person in question had not yet re-routed back her telephone. On occasions when this was not clear, the secretary often told the caller that the person she wanted to get hold off was busy at the moment, and surprisingly often "why," asking her if she wanted to leave a message. This often triggered the caller to express why she was calling, often in some length. The outcome of this was that the secretary sometimes decided to let the call through, sometimes to screen it. This decision was, participants thus argued, virtually always right, and, according to the

secretaries, callers seldom questioned if they were not offered to talk to the person they sought.

The ways in which the secretaries cope with re-routed telephone calls shed light on the presence of both plans and situated action. The secretaries are provided with some instructions concerning which caller to "let through" which they seem to follow. However, the decision seems also to be based on local knowledge, experiences, the caller's explanation of why she is calling, etc., i.e., situated issues that do not make much sense to try to detail in advance. To us this indicates, first, that the accessibility mechanism discussed previously promises to offer relevant support, but also, and second, that such mechanisms probably would need to be accompanied with features that operate closer to the actual process of negotiating interaction.

With the ambition to "ground" the design of such artifacts in the empirical investigations, we wish to point out two important issues in the process of coping effectively with telephone calls, namely the seemingly importance of making: (1) the sender aware of the receiver's work and intentions, and (2) the receiver aware that a particular person wants to join together with her in a session. Let us consider these two issues in more detail.

It seems as if the sender is able to understand whether it is appropriate or not to launch a session with a particular receiver based on information about what she currently is doing and what her plans are. According to the secretaries, callers virtually never complain about not being offered to talk to the person to whom they wish to get hold when the secretaries have told them about what the sought person currently is doing: "They [the callers] understand that other things are more important," as one secretary put it. At the same time participants argued that the secretaries most often let through calls that are "important enough." Furthermore, it seems as if the secretaries, and the receivers, are able to draw various important conclusions only from knowing who is trying to establish a session. One example is the situation where the receiver accidentally happened to understand that a particular person was trying to reach her. Similarly, the secretaries know by experience that certain persons should be re-routed to the receiver.

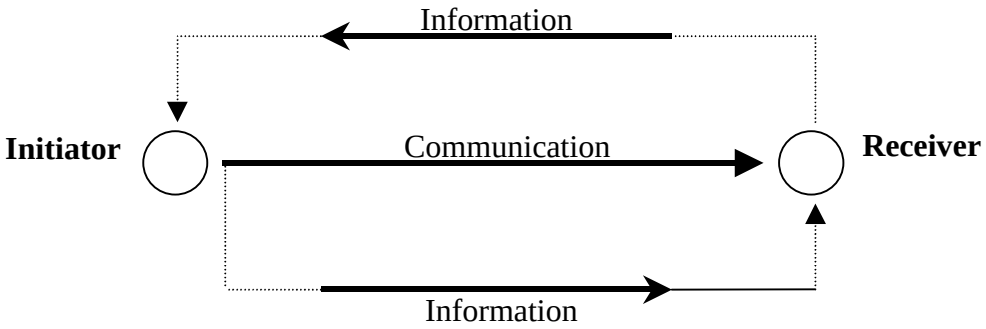
These observations suggest, first, that not only the receiver can play an important role in decreasing the communication problem, and second, the importance of awareness support, both for the sender and the receiver. We suggest an "awareness mechanism" for offering such support. Awareness[1] has been defined as "…an understanding of the activities of others, which provides a context for your own activity" (Dourish 1993, p. 107). We believe this definition agrees with what the awareness mechanism seeks to achieve: to make the sender understand the receiver's doings, and vice versa, in the process of establishing interaction. Streitz et al. (Streitz et al. 1992) use the term "loosely coupled" to describe this kind of co-operation.

The awareness mechanism helps people to form an understanding of the activities of remote people. It does so by providing information that represents what goes on. Here we can make a distinction between two roles: the initiator[2] and the receiver. The initiator is the person who requests interaction, i.e., a communication or collaboration session. The receiver is the person who is requested to join interaction. Information to the initiator can be representations like schedules or messages, or actual actions like "systems in use." Information to the receiver is that the initiator has the intention to interact with her. Examples of information items are who the initiator is, what system she uses, and the topic of the interaction. The awareness mechanism is illustrated in the figure below.

1.The notion of "awareness" has been used in many different contexts in CSCW, among others, to denote: objects' knowing of each others in collaborative virtual environments (Benford and Fahlén 1993; Rodden 1996), awareness among dispersed actors working in the same "media space" (Bly et al. 1993; Dourish et al. 1996), social awareness among participants at the same workplace (Tollmar et al. 1996), co-ordination of activities in synchronous groupware (Baecker et al. 1993; Guttwin et al. 1996), notification of past activities in CSCW systems (Fuchs et al. 1995).

2.We do not use "sender" because it tends to make us think about communication only.

Figure 4: The awareness mechanism helps remote people to form an understanding of each other's activities by providing information about what goes on. The receiver is informed that the initiator request interaction, the initiator is informed what the receiver does.



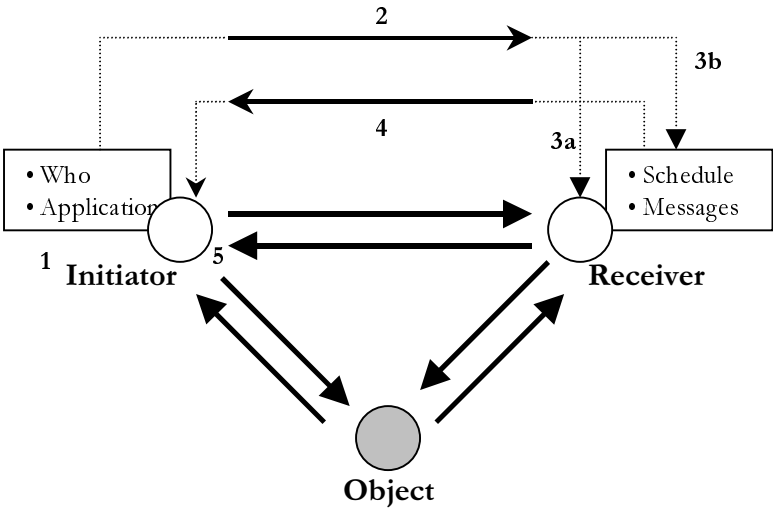
4. The Interaction Manager: Realizing the mechanisms in a prototype

In this section, we outline the “Interaction Manager,” which is a prototype application running on the Windows95 platform. The Interaction Manager is an attempt to implement the two mechanisms explored above.

For obvious reasons, we did not want to do any software updates in the applications on which the mechanisms would operate. We wanted an easy way to implement and demonstrate the mechanisms. The Interaction Manager could be seen as an entry point for PC based interactions. For example, if you want to interact with someone else using CUSeeMe (a video conferencing application for the Internet), then you do not launch CUSeeMe. Instead, you choose CUSeeMe in the list of available CSCW applications provided by the Interaction Manager, which in turn starts the session. This is an easy but yet effective way of implementing the mechanisms without touching the source code in any other applications.

Let us consider in some more detail the process of setting up a session. It starts with one person, “the initiator,” who wants to interact with someone else. The initiator chooses in the Interaction Manager “who” to interact with using “what” application (1 in figure 5 below). The Interaction Manager sends a request (2) to the receiver's Interaction Manager. The request does two things. First, it asks the receiver about her available applications (for the particular initiator in question) and her plans for the day (schedule and optional messages). Second, it notifies the receiver about the initiator actions. The returned request (4) is displayed for the initiator together with her available applications matching the receiver's preferences. The initiator starts an interaction by selecting a system from the list (5).

Figure 5: Setting up a session.



Let us now consider how the two mechanisms are realized in the Interaction Manager.

4.1 The accessibility mechanism

The basic feature of the accessibility mechanism is to offer people to prescribe *who* they wish to interact with using *what* application. Accessibility can be prescribed for "everybody" and "certain participants."

The applications accessible for everybody can either be "running" or "started on request." The latter simply means that a not running application automatically is launched when an initiator requests it. The main reason is to enable people to be accessible by any number of applications without running out of internal memory.

The same technique is used for filtering, i.e., to enable people to specify for whom to be accessible in what application. This is done as follows. First, the Interaction Manager matches the identity of the initiator with the receiver's preferences. The identity of the initiator is obtained from the request (2 in figure 5). Second, if these match, i.e., that person P is allowed to start a session in application A, then the Interaction Manager starts the CSCW application in question. As a consequence, when the initiator launches an interaction session in the particular application, the receiver is accessible.

4.2 The awareness mechanism

The awareness mechanism seeks to make "the initiator" and "the receiver" mutually aware of each other's activities in the process of setting up interaction. The mechanisms seeks to inform "the initiator" about "the receiver's" work; more specifically, her schedule for the particular day and two optional messages, and notify the receiver that a particular person wishes to join together with her in a session. Taking seriously the mobile nature of much work at the pharmaceutical company, which has been investigated elsewhere (Kristoffersen and Ljungberg 1998), we have also tried to implement awareness features for the mobile actor.

Let us first consider how the awareness mechanism seeks to make the receiver aware. This part of the awareness mechanism is concerned with making participants aware of initiators who submit a request to the Interaction Manager, that is to say, others who

probably want to interact. Requests can be notified on the PC, on a cellular phone, or both. If the user selects to be notified on a cellular phone, then the Interaction Manager replies all, or certain, requests to the dedicated phone.[1] The cellular phone "beeps" when it displays the message, which is the name of the initiator. On the PC, the name of the initiator is displayed in the menu bar.

In supporting the sender's awareness of the receiver's work and plans, we decided not to use a real-time video connection, such as the "glance" function used in many video-mediated systems (Dourish 1993; Tang and Rua 1994), but textual representations of work. The main reason why is that video does not sit well with the accessibility mechanism (i.e., filtering). For example, what if the sender after a glance realizes that the other part, who seemed not to be working at the moment, does not want to interact with her? Another issue that could be raised against video is the privacy problem (Bellotti and Sellen 1993; Hudson and Smith 1996).

In trying to offer textual representations of work, we wanted to, as far as possible, and unlike some other applications offering "textual awareness" (e.g., the "@Work" (Tollmar et al. 1996)), rely on already existing information. We did not want to ask users to do work from which they would not benefit (Grudin 1994). The already existing textual representation we use is electronic calendars. Calendar applications were once used as the standard example of "why groupware applications fail" (Grudin 1989), but are, according to more recent empirical investigations used in organizations today (Grudin and Palen 1995). The Interaction Manager transfers on a daily basis information from the calendar application. This information is replicated to those initiators for which the receiver in question wishes to expose her plans. Users can currently choose to show her schedule for "everybody," "nobody," or "certain persons."

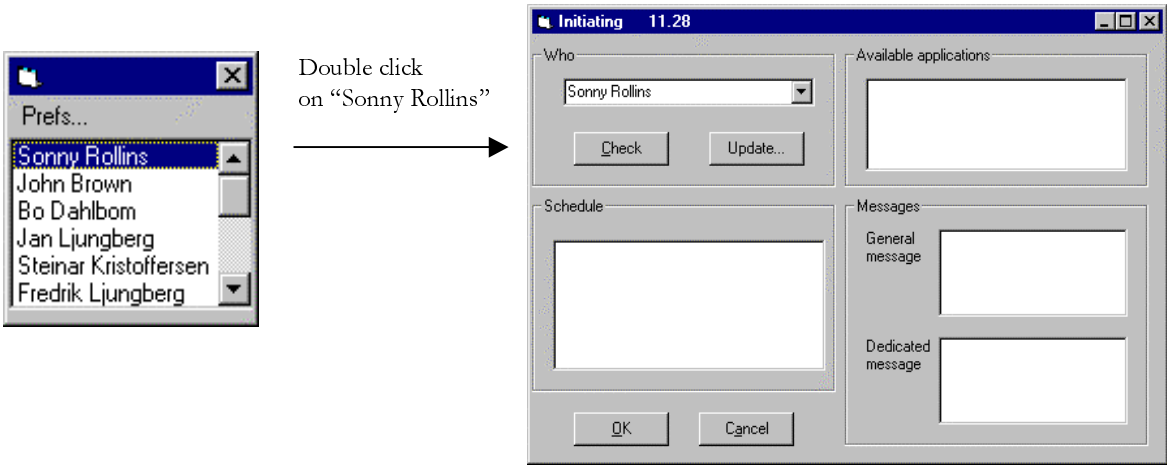
Additionally, the prototype lets the user put together two kinds of messages to be replicated along with the calendar information: the general message and the dedicated message. The general message is exposed for all initiators, while dedicated messages - not surprisingly - are addressed to certain initiators. The messages would typically be used for "pre-interaction co-ordination" (Tang et al. 1994), i.e., to co-ordinate the process of setting up successful sessions, e.g., inform certain participants that one works in another office for the particular day.

4.3 A use case

For the user, the Interaction Manager appears as a small window instantly on top of the desktop. To initiate a session, the initiator double clicks on the name of the receiver, or selects "Start..." in the "Prefs..." menu (2). Then the initiating window emerges. In the example below, the user double clicks on the person "Sonny Rollins."

1.The messages are sent as SMS (Short Message Service) messages

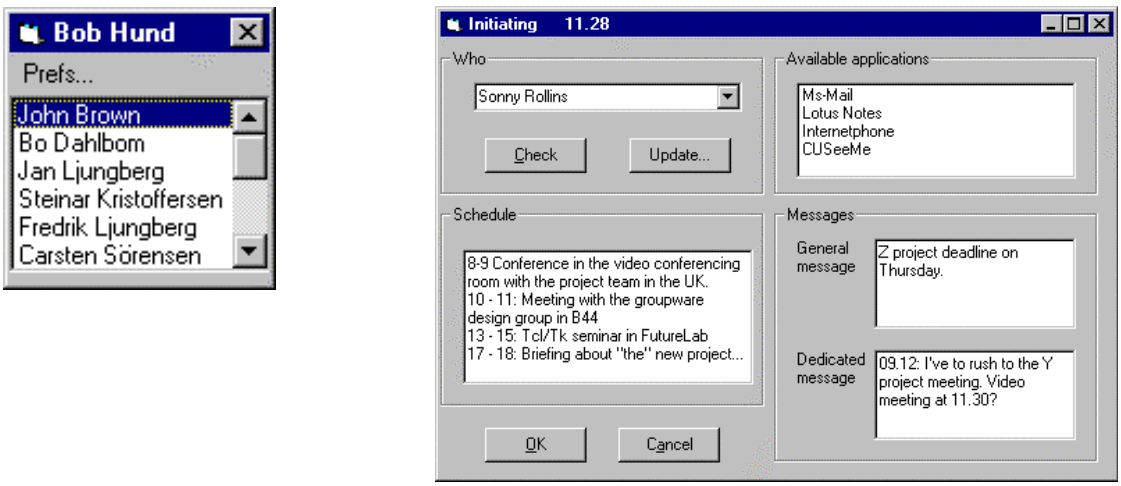
Figure 6: When the initiator marks the receiver for request (left), the "initiating window" emerges (right).



To make a request for the selected receiver, the initiator presses "enter" when the "initiation window" emerges. She can also select another person in the address book, or make a new entry ("Update..." button). By pressing the "OK" button, the initiator sends a request to the receiver.

Upon receiving the request, the Interaction Manager of the receiver notifies "who" is making the request by displaying the name and beep. In the example below, the initiator called "Bob Hund" is displayed (figure 7, left). Based on the preferences of the receiver, the Interaction Manager makes a reply to the initiator (figure 7, right). To start a session, the initiator simply clicks on the application she prefers.

Figure 7: To the left: The receiver is notified that the initiator, named "Bob Hund," makes a request. To the right: The initiator has received the calendar information and massages from the receiver. By clicking on any of the "available applications" (upper right corner), she starts an interaction.



5. Discussion

In this section, we discuss the use of the Interaction Manager and how our work relates to existing research.

5.1 Using the Interaction Manager

This section first explores how the Interaction Manager actually supports users. Because the problem that the prototype seeks to decrease is experienced by the receiver, while it is the initiator who is requested to do most of its operations, the second part of the section explores: why we would expect initiators to use the system?

5.1.1 How would the mechanisms decrease the problem?

The objective defined in the introduction of this paper was to enable constant accessibility to *CSCW technologies* without inappropriate *interaction*. Here we address: How would the accessibility and awareness mechanisms facilitate participants in realizing the objective?

Inasmuch as user-implemented plans reflect what interaction people actually wish to receive, then the accessibility mechanism promises to facilitate people in screening unfortunate interaction. Despite the inherent problem with plans, filtering has been successfully used in other areas, such as message filtering (Mackay 1989). Its potential to reduce the problem addressed in this paper seems difficult to deny.

Used the other way around, the accessibility mechanism could reduce the amount of missed fortunate interaction by enabling people to extend their accessibility to situations where they currently cannot be accessible without running the risk of being spawned with unfortunate disruptions. One example is to be accessible for a particular, and presumably very important awaiting session while hosting a meeting at one's office, i.e., a situation where people currently cannot be accessible at all without running the risk of disrupting the entire meeting - at least not without taking organizational measures.

The schedule and the two messages offered by the awareness mechanism would expose more or less explicitly the participants' preferences of certain sessions. Exposing this information would aim to avoid unfortunate interaction but also to find opportunities for interaction. Information about people's work could be very informative even if it does not state their preferences explicitly. For example, if one person's schedule says: “9 - 10: Meeting with senior management at the office,” then her preferences for that particular hour are quite clear. The messages offered by the awareness mechanism could be used to more explicitly invite people to behave in certain ways.

The notification of requests seeks to make participants aware of others who probably want to interact with them. Its main benefit seems to be making participants aware of potentially relevant sessions that they had failed to notice otherwise, primarily because: (1) the interaction had been screened by the accessibility mechanism, or; (2) the receiver was out of her office and thus not accessible for most CSCW technologies. If users, in becoming aware of such interaction, assess them as desirable, and in doing so, contact the sender to set up a session, then the notification feature has in a sense facilitated people in reducing the amount of missed fortunate sessions. Used the opposite way, the notification message could, hypothetically, be used for screening: if the receiver is notified that an unfortunate person is trying to set up a sessions and realizes that this person has access to some of her systems, then she could shut down these systems immediately to screen the unfortunate session.

In table 1, we summarize the ways in which the two mechanisms would help the users.

Table 1: Summary of the support provided by the two mechanisms.

Table 2:

Mechanism	Function	Unfortunate interaction	Missed fortunate interaction
Accessibility mechanism	Filtering	Screening	Extend accessibility.
Awareness mechanisms (initiator)	Exposing preferences	Make others aware to avoid.	Make others aware to find opportunity.
Awareness mechanisms (receiver)	Notifying requests	Disconnect when being notified.	Requesting a session when being notified.

5.1.2 Why would the initiator use it?

The problem that the Interaction Manager seeks to decrease is experienced by receivers, but it is initiators who have to do most of its operations. The question that then occurs is: why would senders use the system?

We maintain that the application would not bring much extra-work for the initiator, in fact only selecting the name of the receiver (two "enters" or "clicks" if the person is registered in the address book) and waiting until the request is replied. Then the user would only select the desired system to set up a session. Notice that these additional operations would facilitate the sender in exactly what she is trying to do, i.e., set up a session together with a certain person:

The awareness features would give her valuable information about when (etc.) to interact with the receiver.

The notification features would make the receiver aware that the initiator is trying to set up a session: (1) requests could be notified both on the PC and the cellular phone; (2) the application that the sender wants to use does not have to be running to notify the receiver.

The sender would fail to activate the receiver's "start on request" if she does not use the application.

Based on these observations, we maintain that the initiator, first, would not have to do many additional operations to use the Interaction Manager, and second, actually would be facilitated in what she is trying to do: set up a session with the receiver. Therefore, we think the initiator would use the application.

5.2 Related work

This section describes how the research presented here relates to existing CSCW research.

5.2.1 The topic

Some recent empirical studies of collaboration argue for *the importance of interruptions* in work (Whittaker et al. 1994; Bowers et al. 1995; Rouncefield et al. 1995). These studies imply that much work actually becomes triggered and done through interruptions. This observation is indeed important, among other, because it eventually dissolves the old notion of communication as something that inevitably "interrupts work" in a negative sense (Conradson 1988). At the same time, we want to maintain, the observation *cannot* be generalized to all situations, which the authors cited above probably would not claim. Our observations of work suggest to us, as do participants: even though interaction is one of the foundations of work at the company, any interaction is not inherently good in any situation.

Indirectly related to the problem and approach taken in this paper are research on awareness among people to facilitate their collaboration (e.g., Kraut et al. 1990; Heath and Luff 1992), resumption of interrupted and not yet completed activities (e.g., Dix et al. 1996; Dix et al. 1996), and information filtering (e.g., Malone et al. 1987; Belkin and Croft 1992).

5.2.2 CSCW models

The manner in which people can join together in CSCW sessions is defined by the session management model used by the system (Patterson et al. 1990). Edwards (Edwards 1994) makes a distinction between explicit and implicit session management models, where explicit models, opposed to implicit, require participants to take dedicated actions additional to the work itself to initiate a CSCW session. Implicit session management models that are described in the literature are based on artifact (e.g., Grønbæk et al. 1993; Edwards 1994), activity (Edwards 1994; Isaacs et al. 1996) and the place metaphor (e.g., Mantei et al. 1991; Sohlenkamp and Chewlos 1994; Fitzpatrick et al. 1995; Roseman and Greenberg 1996), assuming that participants wish to join together in sessions when they use the same artifact, e.g., a document, when they are involved in the same activity, e.g., using the same system, or when they are at the same gathering point in a place based groupware. The difficulties associated with setting up sessions automatically based on activity and artifact (Isaacs et al. 1996) could be one reason why few systems use these models. Workflow systems, which often use some kind of activity based model, is one exception. Place based models, e.g., collaborative virtual environments (e.g., Greenhalgh and Benford 1995; Nakanishi et al. 1996), continuos connections between physical places (e.g., Fish et al. 1990), and virtual collaboration rooms (e.g., Roseman and Greenberg 1996), are based on how people meet each others in the real world and the problem addressed in this paper does not seem to emerge in such environments.

Even though applications that use an explicit session management model would be most natural to combine with the Interaction Manager, the prototype could have been used together with virtually all systems that do not automatically *set up* collaboration sessions. Systems that only *notify* participants about others' doings, such as *Piazza* (Isaacs et al. 1996) and *@Work* (Tollmar et al. 1996), could be used together with the prototype. Applications based on explicit session management, such as many so called “videophones”(e.g., RAVE's “vphone” operation (Dourish 1993, p. 128)) require participants to explicitly negotiate about setting up a session.

5.2.3 Plans vs. situated action

The work on accessibility and awareness mechanisms presented in this paper relates to a central debate in CSCW: “plans” vs. “situated action.” The option to prescribe actions in advance, as an accessibility mechanism does, provides the user with the possibility to make things happen according to a plan. The relation between people's plans and what they actually do, or want to do, is indeed a complex topic. One observation that has been increasingly accepted in this respect is the potential difficulties in only letting people prescribe their actions in advance, such as many of the old office automation system did (cf., Bannon 1993). It is often very challenging to consider all pertinent issues, even if the work process is seemingly easy to define (Gasser 1986; Sachs 1995). Furthermore, what actions that are applicable in a particular situation partially derive from the local and often unique circumstances (Suchman 1987).

These insights imply that the accessibility mechanism, even though potentially very important only partially realize our objective. Research on filtering to avoid “information overload” (Hiltz and Turoff 1985) and “the junk-mail problem” (Denning 1982) makes the same suggestion. Filtering is very effective in many situations (Malone et al. 1987; Mackay 1989). However, it only takes into consideration what the user specified in advance (Maltz and Ehrlich 1995). Thus, if a particular situation differs from what was calculated, then

there are probably more pertinent actions than those the filter actually executes. Because the accessibility mechanism is a filter, i.e., a user-implemented plan that is executed automatically under certain conditions, it could be criticized in the same way. However, opposed to most applications that provide filtering features, the suggestion we make in this paper is to *complement* the filtering features. The awareness mechanism aims to provide people with support in the actual situation where interaction is set up (or not). By combining the filtering features (the accessibility mechanism) with awareness support, we assert the known problems with filtering partially will be reduced.

6. Conclusions

In this paper, we have explored mechanisms that could help people come closer to the objective of being constant accessible to CSCW technologies without running the risk of inappropriate interaction. Such mechanisms should help people extend accessibility and decrease inappropriate interaction. Based on empirical studies at a pharmaceutical research company, we identified two mechanisms for this purpose: the accessibility and the awareness mechanism. The accessibility mechanism filters incoming interaction based on the accessibility plan of the user. The awareness mechanism helps people to form an understanding of the activities of remote people.

In order to explore how the two mechanisms could be realized, we designed the Interaction Manager. This is a prototype application that seeks to enable people to extend the interaction in which they are involved. Let us now consider the ways in which the two mechanisms could extend accessibility and decrease inappropriate interaction.

Accessibility mechanism:

How would it extend accessibility?

- The receiver can extend her accessibility to situations where she previously could not be accessible without inappropriate interaction.

How would it decrease inappropriate interaction?

- The receiver can screen particular interaction.

Awareness mechanism:

How would it extend accessibility?

- The initiator can be informed explicitly by the receiver about good opportunities for interaction.
- Based on information about receiver's doings, the initiator can understand when it is a good opportunity for interaction.
- Upon being displayed with requests from the initiator, the receiver recognizes that particular interaction is appropriate, thus the receiver seeks to make sure that interaction with the initiator is established.

How would it decrease inappropriate interaction?

- The initiator understands that the current work context of the receiver makes interaction with her inappropriate.
- The receiver disconnects when being notified about requests.

Against this background, we conclude that the two mechanisms suggested in this paper are likely to help us in our struggle to enable “constant accessibility without inappropriate interaction.” We do not claim to have achieved the objective once and for all. We do suggest, however, that the mechanisms have taken us closer to the objective.

Perhaps needless to say, there is much work still to be done. The mechanisms suggested need to be implemented in more applications and tested out in different environments. We also feel that the awareness mechanism needs to be elaborated on further, and

perhaps even distinguished into several different mechanisms. We also encourage more empirical investigations on the topic. Even though one of our studies was quite extensive, we still think there is much left to be learned about interaction and CSCW technologies in the context of work.

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